ANNUAL ADDRESS.

Notes on the Mealy-Bugs of Economic Importance in Hawaii.

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(Presented at the meeting of December 7, 1922.)

These notes have resulted from a study of our common dactylopiine species [1] made preparatory to handling the material collected by H. T. Osborn in Mexico, which, during the past few months, has been chiefly mealy-bug enemies. Mr. Osborn's investigations in this field began primarily with the definite purpose of introducing and acclimatizing the coccinellid beetle *Hyperaspis silvestrii,* observed by Koebele and Silvestri to be an important enemy of *Pseudococcus nipae* in Mexico. The pursuit of this object led him gradually to widen the scope of his work, with the result that we have received from him numerous and sizable shipments of four species of coccinellid beetles, in addition to *Hyperaspis silvestrii,* and five or six internal parasites of mealy-bug species existing here. While the extent of Mr. Osborn's achievement in Mexico could scarcely be anticipated, the results amply justify a belief which I have held for some years; namely, that, in view of the comparative scarcity of some of the species existing here which are attacked by internal parasites, it should be possible to ameliorate present conditions with regard to other species unchecked by internal parasites, by seeking out such enemies as exist and introducing them here. I believe all of the economically important mealy-bug species found here have been brought to the islands in the course of time with plants. In some cases, one or other of their enemies have been brought with them, or have since been purposely introduced. Undoubtedly the present situation with regard to mealy-bug infestations represents a great improvement over the

Proc. Haw. Ent. Soc., V, No. 2, September, 1923.

[1] According to list following. *Eriococcus araucariae* and species of *Asterolecanium* omitted from consideration, as *Eriococcus* and allies and *Asterolecanium* and allies are now viewed as separate subfamilies. The affinities of *Phyllococcus* also being in question, that genus has not been included in the present discussion either.

conditions prevailing, say twenty or twenty-five years ago, and much of this improvement is due to the excellent work done by the numerous species of coccinellid beetles introduced by Koebele from the Orient and Australia. But with regard to most of the species, and particularly those infesting crop plants, the present situation is far from being satisfactory, and a remedy should be sought in the way I have indicated. Mr. Osborn's work in Mexico furnishes an example of what can be done.

In carrying out an idea of this sort, a primary concern is to learn the center of distribution of the noxious species, and to that end all the data bearing on this point should be collected and carefully considered. Unfortunately, in some cases, the available data is valueless for the purpose mentioned. In that contingency, the only recourse is to investigate one zoological region after another until a fruitful one is found. In other cases, however, the way is clearly marked.

The point is here made that conversely to the proposition above stated, the presence of several or numerous parasites of a noxious species in any definite region is *prima facie* evidence on the origin or center of distribution of the species. Such evidence is now available for three of our species, and Mr. Timberlake has pointed out the weight of evidence with regard to two others.

Another important consideration in an undertaking of this kind is ability to recognize any particular species in hand. The main purpose of my study was to familiarize myself with the different species, so that the material sent in could be handled with safety and utilized to the greatest advantage. After gaining a thorough knowledge of the species, it was easy to formulate the keys here given to the subfamily, genera, and species under consideration, which may be useful to others working on this group of insects. Thanks to the careful and painstaking work of Ferris, Morrison, and others, who have pointed out the greater dependability of morphological characters, the distinction of mealy-bug species now rests upon much surer ground than formerly. With regard to the keys just mentioned, I will say that I have tried, in the case of species, to combine morphological characters in a table with the more obvious distinguishing marks or traits. I have also sought to indicate my views as

to the relationships of the different genera and species. And where I could facilitate access to species in nature or in the literature by giving data or references I have done so. A few drawings are furnished to illustrate obscure points in the descriptions.

According to the latest classifications of the Coccidae, the subfamilies Monophlebinae, Ortheziinae, Eriococcinae, Dactylopiinae, Asterolecaniinae, Coccinae, and Diaspinae include all the Hawaiian species, and the following key will indicate the distinction of the species under consideration.

KEY TO SUBFAMILIES.

1. Body covered by a firm waxy scale separable from the insect and made up in part of larval exuviae; legs lacking; posterior end of the abdomen pygidiform ..... *Diaspinae*
   Not so 2
2. With two or more pairs of abdominal spiracles, anal ring placed dorsally some distance before the body apex and not at the end of a cleft 3
   Without abdominal spiracles, anal ring placed at or close to the body apex, or if dorsally, at the anterior end of a cleft in the body... 4
3. With not more than two pairs of abdominal spiracles, anal ring without setae ..... *Monophlebinae*
   With seven pairs of abdominal spiracles, anal ring with setae. *Ortheziinae*
4. Body usually with the posterior extremity cleft, anal opening at the anterior end of this cleft and covered by a pair of triangular plates; these characters more or less obscured in the species that are covered with wax..... *Coccinae*
   Posterior extremity of body not cleft, sometimes more or less indented, but never with plates over anal opening..... 5
5. Body margin with a row of eight-shaped gland pores; legs wanting; antennae very much reduced, minute..... *Asterolecaniinae*
   Not so 6
6. Dorsal ostioles present..... *Dactylopiinae*
   Dorsal ostioles absent..... *Eriococcinae*

The group Dactylopiinae as delimited for the purposes of this paper comprises the following species, listed under their respective genera according to the author's conception of their affiliation. The synonymy is also indicated.

Genus Antonina Signoret.

bambusae (Mask.).

vide Morrison, Pr. U. S. N. M., 60, p. 55 (1922); Green, Coccidae of Ceylon, Pt. V (1922).
Sphaerococcus bambusae Mask. N. Z. Trans., XXV, p. 237 (1892).
Chaetococcus bambusae (Mask.) Ckll. Rev. Mus. Paul., III, p. 501 (1898).
Kermicus bambusae (Mask.) Ckll. Entomologist, XXXII, p. 93 (1899).

crawi Ckll.

Psyche IX, p. 71 (1900); Kuwana, Pr. Cal. Ac. Sci. 3, III, p. 57 (1902); Ehrhorn Pr. H. E. S., III, p. 236.

indica Green.

Mem. Dep. Ag. India, II, 2, p. 27 (1908) Fig.
Antonina boutelouae auct. *vide* Ehrhorn, Pr. H. E. S., III, p. 282.

Genus Geococcus Green.

radicum Green.

Ent. Mo. Mag., XXXVIII, p. 262 (1902).
Ripersiella rhizophilla Fullaway & Kotinsky (*sine* descr.) Ent. News, XXI, p. 49 (1910); Fullaway, Pr. H. E. S., II, p. 108.

Genus Ferrisia *Novum.*

virgata (Ckll.).

Dactylopius virgatus Ckll. Entomologist, XXVI, p. 178 (1893).
Pseudococcus virgatus (Ckll.). Kirkaldy, F. H., III (2), p. 103 (1902).

Genus Trionymus Berg.

sacchari (Ckll.).

Dactylopius sacchari Ckll. Jn. Trin. Nat. Club, II, p. 195 (1895).
Pseudococcus sacchari (Ckll.). Ehrhorn Pr. H. E. S., III, p. 1 (1913).
Pseudococcus calceolariae auct. Ehrhorn loc. cit.

calceolariae (Mask.).

Dactylopius calceolariae Mask. N. Z. Trans. XI, p. 218 (1878).
Pseudococcus calceolariae (Mask.). Kirkaldy F. H., III (2), p. 103.
Pseudococcus sacchari auct. *vide* Ehrhorn loc. cit.
Pseudococcus saccharifolii auct. Ferris in litt.

lounsburyi (Brain).

Pseudococcus lounsburyi Brain An. Ent. Soc. Am., V, p. 179 (1912), Figs.

insularis Ehrhorn.

Pr. H. E. S., III, p. 244 (1915).

Genus Pseudococcus Westwood.

nipæ (Mask.).

Dactylopius nipae Mask. Tr. & Pr., N. Z. Inst., 1892, XXV, p. 232 (1893), Figs.

filamentosus (Ckll.).

Dactylopius filamentosus Ckll. Entomologist, XXVI, p. 268 (1893).
Pseudococcus vastator (Mask.) Kirkaldy F. H., III (2), p. 103 (1902).

kraunhiae (Kuwana).

Dactylopius kraunhiae Kuw. Pr. Cal. Ac. Sci. (3), III, p. 55 (1902), Figs.
Pseudococcus citri auct.

longispinus (Targ.).

Dactylopius longispinus Targ. Cat., p. 32 (1869).
Pseudococcus adonidum (Linn.). Kirkaldy F. H., III (2), p. 103 (1902).

brevipes (Ckll.).

Dactylopius brevipes Ckll. Entomologist, XXVI, p. 267 (1893).
Pseudococcus bromeliae auct. *vide* Science n. s., LV, 1422, March 31, 1922, and LVI, 1446, September 15, 1922.

Genus Tylococcus Newst.

giffardi Ehrhorn.

Pr. H. E. S., III, p. 243 (1915).

Genus Ripersia Sign.

palmarum Ehrhorn.

Pr. H. E. S., III, p. 245 (1915).

KEY TO GENERA.

1. Abdomen of the adult female posteriorly invaginated, the anal ring at the inner end of this invagination.....*Antonina*
   Not so 2
2. Anal lobes very prominent, chitinous, with a stout sabertooth-like spine at extremity of each lobe and two pairs of chitinous hooks on the dorsum, one pair on the head and the other immediately cephalad of the anal ring.....*Geococcus*
   Not so 3
3. Anal cerarii with two cerarian spines..... 4
   Anal cerarii with more than two cerarian spines..... 6
4. With tubular wax pores in clusters about margins of segments, particularly at caudal end.....*Ferrisia* n. g.
   Not so 5

5. With circular wax pores numerous and closely crowded in derm of caudal segments, numerous dorsal setae, few pairs of cerarii and these on the distal segment or segments of abdomen, body usually elongate ..... *Trionymus*

With circular wax pores less numerous and closely crowded in derm of caudal segments, fewer dorsal setae, many pairs of cerarii, usually seventeen to nineteen, distributed on the abdominal, thoracic, and cephalic segments, body usually of oval form. *Pseudococcus*

6. Antennae eight-segmented, body with marginal tumescences. *Tylococcus*

Antennae six-segmented, body without marginal tumescences *Ripersia*

Genus Antonina Signoret.

Pseudococcine forms without legs in the adult female; with the antennae in the adult female reduced to mere stubs; without recognizable cerarii; with the posterior end of the body more or less invaginated, this invagination forming a tube at the inner end of which is the anal ring. Spiracles very large and conspicuous. Circular, multilocular pores present on the dorsum.

Type of the genus *Antonina purpurea* Sign.

Three species of this genus are commonly found in Hawaii, two on bamboos grown for ornamental purposes, and one on the common lawn and pasture grass *Cynodon dactylon*. They are of no great significance economically.

The species may be distinguished by use of the following key:

1. Entire derm heavily chitinized; large; 8 mm. long..... *bambusae*

Less heavily chitinized, the derm thick only on posterior abdominal segments; smaller 2

2. Abdominal spines fairly stout; body oval (on bamboo)..... *crawi*

Abdominal spines very slender; body rotund (on Bermuda grass).. *indica*

Morrison (Pr. U. S. N. M., 60, p. 56) describes and figures *bambusae*, and it is on the basis of his comparisons (p. 58) that the species is included in *Antonina*. Green gives excellent figures of *indica* and *bambusae* and describes the latter in considerable detail in Part V of the Coccidae of Ceylon.

Genus Geococcus Green.

Pseudococcine form with the antennae set very close together at the front of the head; six-segmented, the terminal segment

large; legs present. Body terminating in a pair of prominent anal lobes with a stout sabertooth-like spine at the extremity of each lobe. Derm with trilocular pores. Anal ring setiferous.

Type of the genus *Geococcus radicum* Green.

A monotypical genus described from Ceylon and, according to Green (loc. cit.), not known elsewhere except in Hawaii. Mr. Ehrhorn, however, has called my attention to the similarity of Kuwana's *Ripersia oryzae* (Bul. Imp. Cent. Ag. Exp. Sta., 1, p. 186, 1907), described from Japanese material collected on the roots of rice and other plants, and in Ent. Mo. Mag., LIX, p. 18, January, 1923, the species is said to occur in the West Indies. The species is fairly common in Hawaii, in a more or less complete pulverulent white waxy sac on the roots of plants (koa, mango, nut-grass, etc.), but of no great significance economically. A good figure and description of the insect is furnished in a paper by the author published in Proc. Haw. Ent. Soc., II, p. 108. Green, in his recently published Pt. V of the Coccidae of Ceylon, also gives excellent figures and redescribes the insect in much detail. No mention, however, has heretofore been made of the chitinized strip of the derm at the margin of the penultimate segment extending inward obliquely and bearing two prominent setae. It is quite plain in stained specimens. Green's figures also fail to show the accessory spines in the adult, although present in the nymph. It is possible that the Hawaiian forms so far observed have all been immature.

Genus Ferrisia *Novum.*

Characterized for the reception of the species hitherto passing under the name of *Pseudococcus virgatus.* A pseudococcine form without a tooth or denticle on the face of the tarsal claw and with eight-segmented antennae, but differing from typical species of *Pseudococcus* by having only a single pair of cerarii, situated on the anal lobes, and by the possession of numerous peculiar wax ducts, which are unusually large and have their mouths surrounded by a small chitinized area bearing one to four small setae.

Type of the genus *Pseudococcus virgatus* (Ckll.).

This is a tropical species with a wide distribution. The facts with regard to this so far elicited have warranted Timberlake's

stating that it points to Oriental origin. The species is treated by Ferris in an article on Mealy-Bugs in Jn. Econ. Ent., XII, p. 297, where the fact in regard to its aberrancy is plainly stated. Ferris describes the morphological characteristics and figures the important distinguishing characters. Morrison in his paper on the Philippine Non-diaspine Coccidae (Phil. Jn. Sci., 17, 2, 1920) and Green in his Coccidae of Ceylon, Pt. V, also figure the essential characters of this species. The latter author gives a rather poor illustration of the insect as it appears in nature.

Genus Trionymus Berg.

Pseudococcine forms with circular wax pores numerous and closely crowded, particularly in the derm of caudal segments; with numerous dorsal setae and few cerarii. Tarsal claw without a denticle and antennae of adult female seven or eight-segmented.

Type of the genus *Trionymus perrisii* (Sign.).

Four species referable to this genus are commonly found in Hawaii, two on sugar-cane, the other two on lilies and Bermuda grass respectively. The species commonly known as the Pink Mealy-Bug, formerly referred to as *Pseudococcus calceolariae* and now believed to be Cockerell's *P. sacchari,* is always present behind the leaf-sheath on sugar-cane, and usually the infestation is extensive. It is a pest of considerable economic importance. The legs, antennae, and certain morphological characters have been figured by Morrison (Phil. Jn. Sci., 17, 2, 1920). The species, formerly misidentified as *P. sacchari* and *P. saccharifolii* but now believed to be Maskell's *calceolariae,* has not heretofore been fully characterized or figured. A brief diagnosis follows, illustrated by drawings:

Trionymus calceolariae (Maskell).

In life.—Concealed beneath the sheathing bases of the leaves of its host, surrounded by masses of wax. It appears slenderer and less rotund than either of the other two species of mealy-bugs occurring in the same situation, and the body color is grayish rather than pinkish, as in those species. The filaments of wax from the penultimate and anal lobes are heavy; and there are also four or five finer filaments cephalad of these on either side. The dorsal covering is mealy and rather light. Oviparous, the ovisac loose and fluffy. Color when heated in KOH lilac, a rose tint being meanwhile

imparted to the liquid. The species is less prevalent than either of the other two, presumably on account of an extensive parasitism.

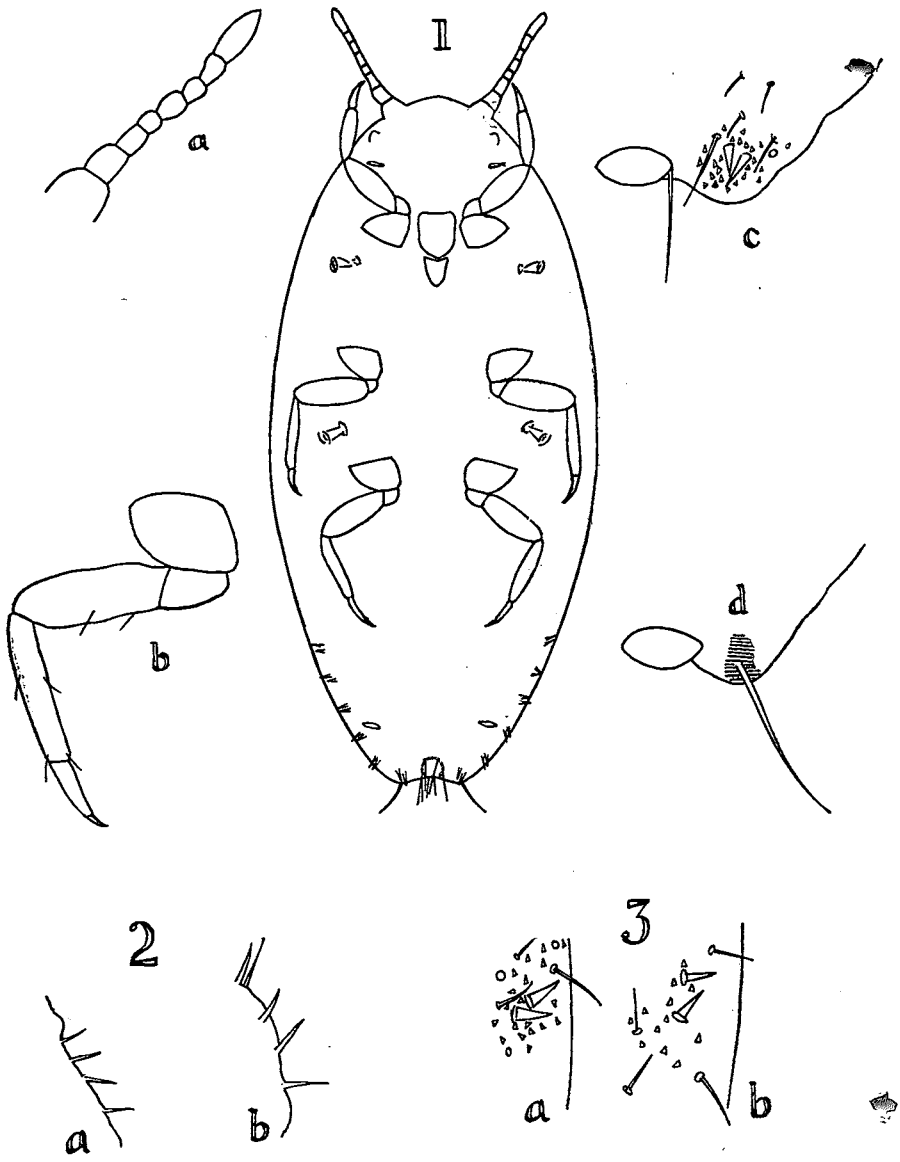
Morphological characteristics.—About twice as long as wide, legs and antennae well developed; i. e., fairly long and thick. Antennae seven or eight segmented, apical segment the longest, one and two stout, second next to apical segment in length and considerably longer than first, though scarcely more than half as wide; third shorter and narrower; fifth, sixth, and seventh (or fifth and sixth in seven-segmented specimens) subequal, fourth smaller. Anal lobes and anal ring fairly well developed. Six pairs of cerarii at the caudal end of body, only the anal lobe pair well developed, the others decreasing in size as they progress toward anterior end of body, and all without chitinizations, but with triangular pores grouped about them fairly closely and accompanied by auxiliary setae. A triangular chitinization (weakly developed in some specimens) on the ventral side of the anal lobe. Anal lobe setae long and fairly stout, somewhat longer and stouter than the anal ring setae. Derm with many triangular pores, small tubular ducts without raised rim about the mouth, and large numbers of multilocular pores, particularly at caudal end of body. Dorsal body setae fairly numerous, particularly so on the head.

Authentication. Authenticated by Ferris, who has examined specimens sent to Green by Maskell himself.

The species heretofore passing under the name of *Pseudococcus lounsburyi* is a pest on lily bulbs, and affects to some extent the growing plants. It would be of considerable importance economically if lilies were more extensively cultivated here than they are. Brain's description and figures of the insect (loc. cit.) are ample. I have, however, figured the anal lobe cerarii of this and the grass-infesting species, *insularis,* to illustrate morphological distinctions referred to in the following key.

KEY TO SPECIES OF TRIONYMUS.

1. Form short oval, width, considerably more than half the length (on sugar-cane and rice) ..... *sacchari*
   Slenderer, width hardly more than half the length 2
2. With six pairs of cerarii on the six posterior abdominal segments (on sugar-cane) ..... *calceolariae*
   With only one or two pairs of cerarii on the ultimate or ultimate and penultimate segments 3
3. With two pairs of cerarii and numerous wax pores (about twenty-five) closely grouped around cerarian spines on anal lobe (on lilies). *lounsburyi*
   With only one pair of cerarii, the anal lobe pair, wax pores around the cerarian spines fewer, not more than twelve, and less closely placed (on Bermuda grass) ..... *insularis*



Trionymus calceolariae.

Genus Pseudococcus Westwood.

Pseudococcine forms with triangular wax pores in the derm predominating over those of the circular type; with many cerarii, usually seventeen to nineteen pairs, distributed among the abdominal, thoracic, and cephalic segments. Tarsal claw without a denticle and antennae of adult female seven or eight segmented.

Type of the genus *Pseudococcus longispinus* (Targ.).

As limited above, the genus comprises but five species in Hawaii, all of which are agricultural or horticultural pests of considerable economic importance and are consequently treated *in extenso*.

The species may be distinguished by use of the following key:

1. Derm with dorsal rows of spines, besides the marginal cerarian spines, the latter toward the middle of the body tending to become widely separated 2

   Derm without dorsal rows of spines..... 3

2. Cerarian spines short and stout, the three pairs of the marginal series in front of the anal lobe pair widely separated.

   Usually occurring individually; ovoviviparous, therefore never developing an ovisac; dorsal secretion in rows of small granular masses, lateral filaments subequal, cylindrical; derm dark red, becoming purple madder when boiled in KOH; wide range of host plants, but commonly found on guava, avocado, palms, Ficus carica, Ficus bengalensis, Sterculia urens, Asparagus spp., mulberry ..... *nipae*

   Cerarian spines longer and more slender, the pairs immediately in front of the anal lobe pair close together.

   Usually occurring in clusters, under cover of densely matted yellowish white wax; the species is oviparous and this covering is the ovisac; eggs purplish; integument shining black, becoming violet carmine when boiled in KOH; secretion heavy,

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Fig. 1. *Trionymus calceolariae* (Mask.) a, antennae; b, leg; c, anal lobe showing cerarii, triangular pores, and auxiliary setae; d, anal lobe, ventral side, showing triangular chitinization.

Fig. 2. *Antonina spp.* abdominal spines; a, *indica;* b, *crawi.*

Fig. 3. *Trionymus spp.* Anal lobe cerarii, triangular wax pores, and auxiliary setae; a, *lounsburyi;* b, *insularis.*

lateral filaments so wide they appear coextensive around margin of body, which is elevated from its base by cushion of waxy filaments, dorsal secretion appearing as four heavy double knob-like masses on each side and some finer filaments extending laterally behind these. Wide range of host plants, but commonly found on citrus, leguminous plants, cotton, hibiscus, Clerodendron squamatum ..... *filamentosus*

3. Cerarii without auxiliary setae, except in the last two abdominal pairs; eighteen pairs of cerarii, each with two spines, filiform at apex, those of the anal lobe cerarii longest, with scattered pores and two or three auxiliary setae, ventral surface of anal lobe with a prominent narrow chitinized streak extending inward obliquely from the base of the large seta, the latter about a third to a half longer than the anal ring setae.

   In life dull brownish yellow, dorsal secretion of wax light, giving body a grayish tinge, a dark median longitudinal streak often apparent; color when boiled in KOH carmine; marginal filaments short and approximately equal in length, those from anal lobe a little longer; oviparous, egg sac formed posteriorly and somewhat spherical in shape, eggs yellow. Wide range of host plants, but commonly found on mango, crotons, pomegranate, Ficus bengalensis (aerial roots), Calathea... *kraunhiae*

Cerarii with auxiliary setae..... 4

4. Anal lobe and penultimate cerarii strongly chitinized, seventeen pairs of cerarii, the first three or four pairs with three or four conical spines, the remainder with two, these increasing in size gradually toward posterior end of body, penultimate pair and anal lobe pair much larger, the latter being extremely stout, all accompanied with numerous pores which are concentrated into a crowded circular area about spines in the case of anal lobe and penultimate cerarii. Ventral side of anal lobes with a large triangular chitinized area, apex directed forward, a narrow thickening along median edge. Anal lobe setae shorter and more slender than anal ring setae.

   In life dull yellowish brown, form long oval, dorsal secretion of wax light with some short filaments, giving body a farinose to grayish tinge; marginal filaments unusually long, lateral filaments half body width, those from anal lobes as long as body, penultimate pair stouter and only half as long; body elevated from its base by cushion of waxy filaments, but ovoviviparous, therefore no egg sac formed; color when boiled in KOH becoming purple lake. Wide range of host plants and particularly in glass-houses on maiden-hair fern, ornamental species of Asparagus, etc..... *longispinus*

Anal lobe cerarii weakly chitinized at most, penultimate pair not chitinized, seventeen pairs of cerarii, all with numerous pores, first

three, the penultimate and the three or four pairs anterior to the penultimate pair usually with three or four spines, those of the anal lobe the largest, no chitinized areas about any of the cerarii, although chitinization is faintly indicated about anal lobe cerarii. Ventral side of anal lobes with quite large chitinized area extending in from the base of the anal lobe setae; anal lobe and anal ring setae nearly equal, one and one-half times diameter anal ring.

In life salmon pink, form oval to short oval, fairly convex, dorsal secretion of wax fairly abundant, hiding the color of the derm; marginal filaments not very long (less than one-fourth width of body) and more or less uniform in length excepting the filaments from the anal lobes and those immediately anterior to them, which grade posteriorly from the length above stated to nearly the full length of the body in the case of those of the anal lobes. Beneath this pair are two short plate-like filaments and some fluffy wax, occasionally a drop of honey-dew. The species is negatively phototropic. It is ovoviviparous, therefore no egg sac is produced. Always present on pineapples, sugar-cane, and bananas, and often found on other plants, particularly on sisal, soursop, and on the roots of cannas, nut-grass, etc.....*brevipes*

Pseudococcus brevipes (Cockerell).

I have accepted Professor Cockerell's suggestion to use the above name for the common species on pineapples, bananas, etc., which has apparently now become widely distributed with the transference of plants from one region to another in the interest of agricultural development. Secretive in habit, it could be overlooked without fault of anyone on plants in transit from one country to another, and this habit has probably aided its dissemination.

The species appears to be partial to bromeliaceous and allied plants, and, in view of the discovery of several internal parasites of it in Central and South America, I consider it indigenous in the tropical portion of the American continent. It does not seem to flourish outside the tropics.

The species (under the name *bromeliae*) is treated by Ferris in a paper entitled "Observations on Some Mealy-Bugs" in Jn. Econ. Ent., XII, p. 296, and a figure given of the distinguishing morphological characters. Ferris established the identity of our species by including it with specimens from Florida and the West Indies, which Cockerell has stated are identical with *brevipes*. Morrison (loc. cit.) and Green (Pt. V, Coccidae

of Ceylon) also figure the morphological characteristics of the species (under the name *bromeliae*).

Ehrhorn considers that Kuwana's *ananassae* is probably the same species.

Pseudococcus nipae (Mask.).

This is another species believed to belong to the tropics of the American continent, although now widely spread through the transference of ornamental plants from one region to another. The belief just mentioned is based on the presence of numerous enemies of this species in Mexico, some of which appear to be rather strict. As already stated, the species is a serious agricultural and horticultural pest, and the Hawaiian Government has recently introduced three species of coccinellid beetles and three internal parasites (two encyrtids and one scelionid) to secure a measure of relief from its attacks on fruit trees and ornamental plants.

The species is treated by Ferris in a publication on "The California Species of Mealy-Bugs" in the Stanford University series, p. 49, and a figure given of the penultimate and anal lobe cerarii and the ventral side of the anal lobe showing the peculiar character of the chitinization and grouping of pores.

Pseudococcus filamentosus (Cockerell).

This is another tropical species now widely distributed, probably on citrus stocks or scions, as it affects citrus very generally and has proved a great hindrance to citrus culture in Hawaii, causing malformation of the terminal growth. According to Koebele it gained entrance to Hawaii about 1891, from Japan. It also affects leguminous plants generally, and in Cairo, Egypt, caused serious injury to leguminous shade-trees in 1909. At that time it was the subject of much study and investigation, which was afterward reported upon in a paper by F. C. Willcocks, entomologist to the Khedevial Agricultural Society, published in the Bull. Ent. Res., I, p. 121. The species was considered as new and was so described by Newstead and Willcocks under the name *Dactylopius perniciosus,* but Kränzlin, in 1913, in describing a similar infestation at Dar-es-Salaam (see Rev. Appl. Ent., II, p. 146), refers the Egyptian and the Tanganyika insect, rightly I believe, to *filamentosus.*

Newstead and Willcocks (loc. cit.), Robinson (Phil. Jn. Sci., XII D, p. 8), and Ferris (Coccidae of Lower California, Stanford U. Pubs. Biol. Ser., I, 2, p. 83) have all described or figured structural details of this species. The account of the first-mentioned authors is particularly full and complete. In this account the authors make the statement: "Small parasitic Hymenoptera belonging to the family Chalcididae appear to play a very important role in the natural control of this pest. Three members of this family have been reared from the mealy-bug." This parasitism of the species in Africa by Chalcids has been confirmed by E. W. Rust, field entomologist of the California State Department of Agriculture, who reared parasites from it in South Africa. The presence of parasites of this species on the African continent and their absence elsewhere leads me to believe that the species is indigenous to that continent. The introduction of these parasites at Hawaii would be a valuable service, and if their establishment could be secured, they would undoubtedly help materially in the control of *P. filamentosus,* which now rests entirely on the work of the polyphagous predators, *Cryptolaemus montrouzieri, Scymnus bipunctatus,* and *Gitonides perspicax.*

Morrison (loc. cit.) also figures the leg, antennae, and certain morphological features of this species, and the present author in Bul. 18, Hawaii Experiment Station, illustrates its appearance in nature.

Pseudococcus kraunhiae Kuwana.

The distinction between *Pseudococcus kraunhiae* and *Pseudococcus citri* is made on the basis of very slight differences. Ferris, however, believes the species can be discriminated in California, and the morphological characteristics of the Hawaiian form, as judged by his standards, point to its identity with the former species rather than the latter. Timberlake brings additional evidence to bear on the question by claiming a biological dissimilarity between the Hawaiian mealy-bug and what passes for *citri* in California. He says: "Whatever species ours is, it it constantly parasitized by the encyrtid *Pauridia peregrina,* while the species in California which goes under the name of *citri* is apparently not receptive to this parasite." Possibly both species are present in Hawaii as well, but this contingency has

never been satisfactorily demonstrated. If, as held by some, *kraunhiae* and *citri* are synonymous, the Hawaiian insect represents a very widely spread and polyphagous species. On the other hand, the distribution of typical *kraunhiae* is very limited, it being confined to Japan and California outside of Hawaii. Once it was recorded from quarantined plants in New Jersey, but the record lacks confirmation. The Hawaiian insect is heavily parasitized by *Leptomastidea abnormis* as well as by *Pauridia peregrina* and is the prey also of other polyphagous mealy-bug enemies. It is, therefore, of much less significance as an agricultural and horticultural pest than some of the other mentioned species, although occasionally a heavy infestation will be observed.

Ferris has described the morphological characteristics of both species in his paper on "The California Species of Mealy-Bugs" (loc. cit.), and figures the distinguishing characters. A good illustration of *P. citri* as it appears in nature, which might well pass for *P. kraunhiae* also, is found in connection with Sanders' paper on "The Identity and Synonymy of Some of Our Soft Scale Insects" in Jn. Econ. Ent., II, p. 428.

Pseudococcus longispinus (Targ.).

This is another tropical or subtropical species of wide distribution and with a wide range of host plants. It is particularly a greenhouse pest, flourishing most luxuriantly in a warm, still, moist atmosphere. Ferris treats this species in his paper on "The California Species of Mealy-Bugs" (loc. cit.), describing the morphological characteristics and giving figures of the important characters. Sanders, in a paper on "The Identity and Synonymy of Some of Our Soft-Scale Insects" (loc. cit.), gives an excellent illustration of this mealy-bug as seen in nature. Green also describes and figures the species in Pt. V of the Coccidae of Ceylon.

Genus Tylococcus Newst.

Pseudococcine forms without a tooth or denticle on the face of the tarsal claw and with eight-segmented antennae, well developed anal ring bearing six long stout setae, and marginal tumescences corresponding to the cerarii, each of which consists of a triangular or scutiform chitinization beset with a

number of stout spines, auxiliary setae, and triangular wax pores, the caudal pair the largest and provided each with a very long seta. Derm with numerous triangular pores, a few circular pores, and setae in rows and patches.

Type of the genus *Tylococcus madagascariensis* Newst.

Only one species referable to this genus is found in Hawaii, viz., *T. giffardi* Ehrhorn. It infests species of *Pandanus,* but without very serious consequences. The species is included because *Pandanus odoratissimus,* which grows wild in Hawaii, is the source of the lahala woven fabrics. Several other forms are cultivated as ornamental plants. The type species is illustrated by Newstead in the original publication, but the figure showing the outline of the body is believed to exaggerate the degree of marginal tumescence.

Genus Ripersa Sign.

Pseudococcine forms with six-segmented antennae in the adult female, without a tooth or denticle on the face of the tarsal claw, with marginal cerarii bearing two or more spines, at least on the caudal segments, and with anal ring bearing six setae. The derm with numerous triangular pores and some circular ones.

Type of the genus *Ripersia corynephori* Sign.

This genus has only one accredited species in Hawaii, viz., *Ripersia palmarum* Ehrhorn. It infests a variety of palms, including the so-called traveler's palm (Ravenalla), but without very serious consequences. It is mentioned here because it is commonly encountered on ornamental palms, where it is difficult to extirpate.